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TAMARIND SEED GUM AS ADHESIVE FOR PELLETING IN TOMATO CV. PKM1

T. SURENDHAR & P. R. RENGANAYAKI*

Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

ABSTRACT

The effect and quality characters of tamarind seed gum as adhesive for seed pelleting in Tomato (Solanum lycopersicum 2n=24) cv.PKM1 was compared with other adhesive in Department of Seed Science and Technology, TNAU, Coimbatore. The tomato seeds were pelleted with sand, Trichoderma viride, fine vermi compost, Pseudomonas fluorescens and TNAU pelleting powder@ratio of 10:1:1:2:1:5using five adhesives viz., Rice gruel, Maida, Gum acacia, CMC, Tamarind gum at different concentration. Both physical and physiological parameters were observed. The seeds pelleted with 8% Tamarind gum produced significantly higher speed of germination, germination percentage (98%), seedling length(11.5), vigour index I (1127), vigour index II(8281). Speed of germination of pelleted seeds (Tamarind gum adhesive used) is better than control.

KEYWORDS: Tamarind, Pseudomonas Fluorescens & Vigour

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Original Article

INTRODUCTION

Seed pelleting is the process of adding inert materials to seeds to increases its weight, size and shape, which allows precise spacing of seed in the field, make planting easier. Pelleting is done by applying solid particle fillers to the seed using a binder or adhesive. Seed, binding agent, coating materials and chemicals are mixed in the rotating drums in the right proportions to uniformly coat the seeds. Too much binding agent and coating material can lead to the formation of solid pellets that contain no seeds called Pseudo pellets.

The process of seed coating usually involves the use of adhesives (also known as glues, binders, or stickers) to bind materials to the surface of seeds; coating without adhesive will usually lead to fragile coats that are extremely prone to dusting and cracking and subsequently to the loss of the active ingredient. The physical integrity of coated seeds is of great importance in any handling, transport, and planting operations. There were relatively rare studies regarding the binding qualities of adhesives used for seed coating. Large differences were observed in performances of adhesive coated seeds. Seeds coated with activated carbon has been successfully achieved with gum arabic plus a plasticizer [1], methyl cellulose [2], or polyvinyl acetate [3]. [4] stated methyl cellulose is most effective adhesive; [5]also evaluated a range of adhesives and coating materials for seed coating, but the number of interactions involved make it difficult to draw general conclusions about the efficacy of particular adhesives. Various authors recommended that the use of adhesives include gum arabic [6, 7]gelatin and casein [8], caseinate salts [9], methyl cellulose [10, 7] In practice, however, methyl cellulose is most widely used due to its ease of use, availability, low cost, and low rate (3% w/v solutions) compared to gum arabic (up to 45% w/v).

An adhesive is selected based on its properties viz., affinity for both seed coat and selected filler material, degree of water solubility, strength and plasticity to prevent dusting and breakage and viscosity for each application.

Tamarind is an economically important and multipurpose tree grown abundantly in India. Tamarind seeds contain 30 % and 70 % of seed coat and kernel respectively. Tamarind kernel powder is a rich source of xyloglucan gum contains glucose, xylose and galactose in the ratio of 4:3:1 [11, 12] mostly used in food industry as thickening, stabilizing and gelling agent. Tamarind seed xyloglucan is a high-molecular-weight polysaccharide (880 kDa), which forms viscous solutions when dissolved in water [13].

So far tamarind seed gum was not tested for its binding as adhesive in seed pelleting. Hence in this work, we have studied the efficacy of tamarind seed gum as adhesive in seed pelleting due to its biodegradable and environmental friendly material can be utilized extensively [14, 15,16].

Tomato (Solanum lycopersicum 2n=24), a self-pollinated crop belongs to the family Solanaceae and cultivated throughout tropical and subtropical countries under outdoor and indoor conditions. It is the world's largest vegetable crops next to potato and sweet potato and tops in commercial vegetables. Tomato fruit is an excellent source of vitamin C (160-240 mg), edible protein (100 g), minerals such as copper (0.01-0.09 mg), manganese (0.09-0.13 mg) and zinc (0.1-0.17 mg) kg-1 of fruit [17]. Tomato consumption has been associated with decreased risk of breast cancer, head and neck cancers and might be strongly protective against neurodegenerative diseases. So it is one of the "Highest perch" because of the antioxidant property. Tomato is said to help lower urinary symptoms and may have anticancer properties. Lycopene has also been shown to improve the skin's ability to protect against harmful UV rays.

Tomato ranks third after potato and onion in India, but ranks second after potato in the world. India ranks second in the area as well as in production of Tomato. The major tomato growing countries are China, USA, Italy, Turkey, India and Egypt. There has been a great competition in the world market for tomato and hence, there is a need to increase the area under tomato, using good variety for which production of quality seeds is mandatory.

MATERIALS AND METHODS

The present investigation was undertaken during 2019. After imposition of seed treatments, the treated seed along with untreated seeds (control) were germinated under shade net conditions at Department of seed science and technology, Tamil Nadu Agricultural University, Tamil Nadu. Different adhesive were used for seed pelleting. The experiment was laid in Randomized Block Design, replicated four times with six treatments.

The treatments were:

T_0 - Control (No Pelleting)

Adhesives Used

T_1 - Rice gruel 2%

T_2 - Maida gruel 2 %

T_3 - Gum acacia 2%

T_4 - CMC 2%

T_5 - Tamarind seed gum 8%

Seed material (PKM 1 certified seed) was harvested at Horticultural college and research institute, periyakulam on 25th October. Sand and vermi compost are sieved to get 0.05 mm fine and uniform material. Filler material which was used for pellet the seeds are fine sand 1g, *Trichoderma viride* 1g, fine vermi compost 2g, *Pseudomonas fluorescens* 1g and 5g of TNAU pelleting powder.

Tamarind Seed Gum Preparation

Tamarind seed was first roasted with continues low temperature. Then seed coat was removed and powdered finely the cotyledon by milling. Eight gram of milled tamarind powder was dissolved in 100ml of water and boiled for 5 minutes in low flame. Then the mixture is cooled under room temperature for 30 minutes and used for experiment. The filler material, adhesive and bio control agents were used to pellet 10g of seeds. Pelleted seeds were air-dried and used for laboratory study.

OBSERVATIONS

Number of Double Seeds

One hundred seeds were selected randomly from each treatment and counted for presence of double seeds in a single pellet.

No. of Pseudo Pellets

One hundred seeds were selected randomly from each treatment and counted for presence of pellets without seed.

Pelleted Seed Weight (g/100 Seeds)

One hundred seeds were selected randomly from each treatment, weighed and expressed in grams.

Single Pellet Length (cm)

Tenpellets were selected randomly for measurement of length of the pellets. Length was observed from tip of the pellet to base of the pellet vertically in stereo zoom microscope.

Single Pellet Breadth (cm)

Tenpellets were selected randomly for measurement of breadth of the pellets. Breadth observed in big size of the pellet horizontally in stereo zoom microscope.

Single Pellet Perimeter (cm)

Ten pellets were selected randomly for measurement of perimeter of the pellets and perimeter was measured with the help of stereo zoom microscope.

Germination Percent (%) (ISTA, 2003)

It refers to the proportion by number of seeds which have produced normal seedlings and total number of seed sown under the conditions and within the period specified that is the percentage of normal seedlings.

Shoot Length (cm)

All normal seedlings was measure for root and shoot length. The shoot length was measured from tip of the

primary leaf to the base of the hypocotyls and mean shoot length was expressed in centimeter.

Root Length (cm)

The root length was measured from the tip of the primary root to base of hypocotyls and mean root length was expressed in centimeter.

Seedling Length (cm)

Seedling length is the best indicator of seed vigour. It is addition of root length and shoot length. The relative length of root and shoot of seedlings would predict their subsequent growth and performance.

Dry Matter (g)

Mean dry weight were determined after ten days of shade drying. Dry matter taken for ten number of normal seedlings.

Vigour Index

The computed vigour index, which is the totality of performance or capacity of seedling, has been regarded as a good index to measure the quality of seed lots.

Vigour index I: Germination (%) x seedling length (cm).

Vigour index II: Germination (%) x seedling Dry matter production (mg).

Speed of Germination (Maguire,1962)

Seeds were germinated in field, soil media with four replications of 100 seed each treatments. The number of seeds germinated was recorded daily from first count up to the day of final count. The speed of germination was calculated by using the formula suggested by Maguire(1962) [18].

RESULT AND DISCUSSIONS

The results were significant among adhesives. The seeds pelleted using tamarind seed gum recorded significantly higher physiological and physical characters. With regard to physical characters the pellets remains intact, without dusting off and breakage. Among the adhesives the seeds pelleted using maida though recorded higher germination, pellets found dusting off and breakage.

Results were significantly differed for almost all parameters. The seeds coated with the use of adhesive tamarind gum given significant higher result for all seed and seedling quality characters. Speed of germination of Maida (14.06) and tamarind gum (14.03)was significantly higher than control (13.91)and on par with one another. Shape and compaction of pelleted seed with tamarind gum is appreciable. Besides carbohydrate, proteins, a good source of fatty acids and rich in some essential minerals, such as Ca, P, Mg and K[19] in tamarind seed powder may contributed for the better results.

The film coat formed around the seed act as a physical barrier which compact due to adhesive, has been reported to reduce leaching of inhibitors from the seed covering and may restrict oxygen diffusion to the embryo. Among the treatments, seed pelleted with Tamarind gum recorded the highest germination of 98% followed by Gum acacia (96%), while the minimum germination was registered by seeds pelleted with Rice (88%). Vigour index I (1127), vigour index II (8281) are significantly higher in Tamarind gum. Lowest vigour was obtained in control Vigour index I

(648), vigour index II (4230). Shoot length is higher in Tamarind gum (5.8) followed by CMC (5.6)both of them were on par with each other. The dry matter of seedlings of Tamarind gum recorded highest (84.5)followed by CMC (62) and the same was almost double over control (47). However hundred seed weight was increased fourfold over control due to additives. It can be taken into positive rather than negative as increase in seed size would increase the seed rate per unit area, but free flow of pelleted seeds reduces the clogging and sowing of bunch of seeds in single hill, so the recommended seed rate can be reduced. However the perimeter of pelleted seeds increased only one and half times of control, pelleting of seeds resulted in increased weight rather than size, which shows the possibility of packing of required materials with the use of tamarind gum is possible without much alteration in seed size. It is must to notice the number of double and pseudo pellet on certification point of view, but when compared to the commercial used gum Arabic, tamarind gum resulted in low number of double and pseudo pellets. [20] evaluated the quality of tamarind seed gum and the better quality of gum was attained in 5min roasted tamarind seeds with maximum polysaccharides. So the tomato seeds coated with tamarind gum showed increased physical and physiological parameters.

Pelleting is one of the most sophisticated seed treatment technology, resulting in changing physical shape of a seed to enhance plant ability and handling. The original purpose of pelleting was to increase seed size for precision planting. Besides the advantage of sophisticated handling, pelleting also provides the opportunity for packing of more than one material and the spatial orientation of active ingredient can be varied within the pellet [21] with the help of adhesives. Adhesives may from natural or synthetic and commercially CMC and gum Arabic are used as adhesives for pelting of seed. CMC is often used as its sodium salt; gum Arabic is imported from Sudan and Sudan dictates the price of gum Arabic. Being organic in nature, possessed with good characteristics of adhesives, tamarind seed gum may act as alternate to these two adhesives. Tamarind seed gum is prepared from roasted endosperm of the tamarind seed, the source of gum contains 15.4 % to 12.7 % protein, 3-7.5 % oil, 7-8.2 % crude fiber, 61-72.2 % non-fibre carbohydrates, 2.45-3.3 % ash exhibits quick solubility; dissolved nutrients may contributed for the better performance of seedlings. Though pelleting had number of benefits, one limitation in pelleting is late germination because of coated materials. But in the present study even before control seeds, the pelleted seeds breaks easily and completed the germination with higher speed of emergence. At present intensive research is carried out on application of tamarind gum in food, pharmaceutical and cosmetics industry.

The benefits realized through use of tamarind gum are, enhanced germination and speed of germination, seedling length, dry matter without much alter in seed size, free flow ability of seeds while sowing. All these enhanced characteristics might be due to presence of nutrients in endosperm of tamarind seeds and ready to dissolve. In the rural part of Tamil Nadu roasted tamarind seeds taken as snacks along with tea perhaps for its nutrient quality and seed protein. All the physical and physiological parameters recorded was positive for tamarind gum as discussed in results further the physic chemical of tamarind gum need to be studied and economics need to be worked out for commercial application as adhesive in seed pelleting. Since tamarind seed is waste generated from agro industry, if the technology is successful, the rural women can get the employability towards the collection and preparation of gum for the purpose.

CONCLUSIONS

This study has shown that seed pelleting techniques may be used to enhance seed of tomato cultivars PKM 1 as a result of their positive effects on germination and seedling performance. Seed pelleting with tamarind seed gum as an adhesive was found to enhance seed germination rate and has ten mean time to germination, both of which are seed vigor indexes. This study suggests a tamarind seed gum used pelleted seeds are given better results or on paired. However,

decoating appears essential for enhanced germination rate and seedling performance.

AUTHORS' CONTRIBUTIONS

Surendhar. T designed the experiment, interpreted the data and writing an original draft. Renganayaki. P. R participated in the review and validation of manuscript.

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APPENDICES

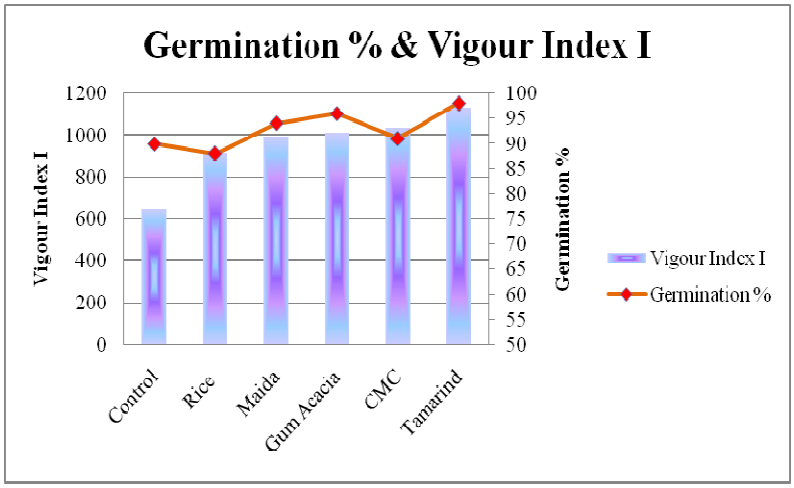

Figure 1: Effect of Tamarind Seed Gum Used Pelleted Seed Germination % and Vigour Index I

Figure 2: Effect of Tamarind Seed Gum Pelleted Seed and Seedling Performance

Table 1: Effect of Physiological Observation on Tamarind Seed Gum used Seed Pelleting

Treatments	Speed of Germination	Root Length (cm)	Shoot Length (cm)	Seedling Length (cm)	Dry matter Production (mg/10 Seedlings)	Vigour Index II
T_0	13.91	3.4	3.8	7.2	47.0	4230
T_1	11.87	5.0	5.4	10.4	80.3	7066
T_2	14.06	5.1	5.5	10.6	76.7	7210
T_3	12.89	5.2	5.3	10.5	72.8	6988
T_4	13.23	5.8	5.6	11.4	62.0	5642
T_5	14.03	5.7	5.8	11.5	84.5	8281
SEd	0.1740	0.0546	0.0736	0.0928	0.9258	125.1317
CD (P=0.05)	0.3656	0.1148	0.1546	0.1950	1.9450	262.8958

Table 2: Effect of Physical Observation on Tamarind Seed Gum used Seed Pelleting

Treatments	100 Seed Weight After Pelleing (g)	Pellet Length (cm)	Pellet Breadth (cm)	Pellet Perimeter (cm)	No. of Double Seeds	No. of Pseudo Pellets
T_0	0.288	3.5	2.5	10.4	0	0
T_1	1.206	4.6	3.1	11.2	15	3
T_2	0.504	3.7	2.6	10.6	12	1
T_3	1.438	4.3	3.4	12.4	35	8
T_4	1.424	5.1	4.7	16.1	8	3
T_5	1.431	4.8	3.9	15.9	27	6
SEd	0.0078	0.0862	0.0514	0.1588	1.3601	0.0931
CD(p=0.05)	0.0164	0.1811	0.1079	0.3336	2.8993	0.1984